REMARKS

The Office Action of December 22, 2005 was received and reviewed. The Examiner is thanked for reviewing this application, for indicating claims 2 and 5 as containing allowable subject matter and for conducting a personal interview and a telephone conference with Applicants' representative on March 2, 2006. Reconsideration and withdrawal of the currently pending rejections are requested for the reasons advanced in detail below.

Claims 1-13 were pending prior to the instant amendment. By this amendment, independent claims 1 and 4 have been amended, new claims 14 and 15 have been added to recite additional features of the present invention to which Applicants are entitled, and claims 8-13 have been withdrawn from consideration in response to an election/restriction requirement. Consequently, claims 1-7 and 14-15 are currently pending in the instant application, of which claims 1 and 4 are independent.

Claims 1 and 3 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Jain et al. (U.S. Patent No. 6,180,533 - hereinafter Jain). Further, claims 4, 6 and 7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Yang et al. (U.S. Patent No. 6,515,328 – hereafter Yang). Finally, claims 2 and 5 stand objected as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. In response, Applicants respectfully traverse the rejection and objections for the reasons provided below.

Initially, claims 1 and 4 have been amended, as shown above, after the telephone conference with the Examiner immediately following the personal interview. Although Applicants do not see any confusion that may be created by the original claim language, Applicants have amended claims 1 and 4 pursuant to the discussion with the Examiner to eliminate any possible confusion therein.

In order to compare and contrast the presently claimed invention, and prior to rebutting the rejections and objections, Applicants would like to summarize the issue and solution that embodies the present invention as follows.

If a trench for isolation is formed in a silicon substrate by using the conventional dry etching method, for example, then etching would be halted halfway. This halting of etching leads to the problem wherein the isolation trench having a desired isolation depth cannot be formed, as described Fig. 14 of the present specification. By studying this etch-halting-

phenomenon, Applicants observed the followings:

After the silicon substrate is placed in the chamber of the dry etching apparatus, the process gas including oxygen is introduced into the chamber. Then, once the plasma is generated from the process gas by applying the source power, the ions (e.g., halogen ions) functioning as an etching species and the oxygen radicals are generated. At this time, the oxygen radicals and an exposed portion of the silicon substrate react with each other to form a thin silicon oxide film on the silicon substrate. In this state, even if the ions in the plasma are drawn into the silicon substrate with application of the bias power, the silicon oxide film, which has an etching speed of one hundredth or less of the etching speed for silicon, is formed on the silicon substrate. Consequently, etching performed with respect to the silicon substrate hardly proceeds. Thus, etching is halted halfway, as described in, e.g., page 10, line 8 to page 11, line 7 of the present specification.

The presently invention is based on the above observation. Specifically, in the present invention, if etching is performed with respect to a material to be etched containing silicon by using the dry etching apparatus having the dual power source, the application of the bias power is initiated to generate plasma before oxidation proceeds at the surface of the material containing silicon. This prevents the situation in which the drawing of the ions from the plasma into the material containing silicon is inhibited by an oxide film formed on the surface of the material containing silicon. Further, the present invention prevents a halfway halt in dry etching performed with respect to the material containing silicon, as disclosed on page 19, line 22 to page 20, line 7 of the present specification.

The above-mentioned advantage is reflected in Applicants' claims 1 and 4. More specifically, claim 1 recites, among other steps, the step of generating the plasma by initiating the application of the bias power before oxidization proceeds at an exposed portion of the silicon substrate, and claim 4 recites, among other steps, the step of generating the plasma by initiating the application of the bias power before oxidization proceeds at an exposed portion of the conductive film.

With respect to Jain, the reference teaches an etching for forming a trench having top and bottom corners rounding on a silicon substrate, and using a dry etching apparatus which provides for separate power control of a plasma generation source and a substrate biasing device. However, Jain completely fails to teach, disclose or suggest the etch-halting-

phenomenon or how to prevent etch-halting from occurring. Further, Jain is complete silent in regard to the time changes of each power and the timing of each power applied such that as shown in the present specification (e.g., Fig. 2). That is, Jain completely fails to disclose how to specifically control the source power and bias power to prevent etch-halting due to the oxidizing of the substrate. Jain merely discloses supplying a process gas composed of chlorine and oxygen to a chamber in which the silicon substrate is provided, and initiating etching of the silicon substrate using source power and bias power.

On the other hand, one of the features of the present invention resides in the application of the bias power which is initiated to generate plasma before oxidization proceeds at the surface of the material containing silicon. Hence, before oxidizing the surface of the material containing silicon, the ions in the plasma generated by the application of the bias power can be drawn into the material containing silicon by the application of the bias power, as disclosed on page 36, line 25 to page 37, line 8. In other words, in the present invention, the etching of the material containing silicon is substantially initiated by the application of the bias power. Applicants respectfully assert that Jain completely fails to teach, disclose or suggest "initiating etching by generating plasma by the application of bias power" as in the present invention, and that Jain completely fails to teach, disclose or suggest generating the plasma by initiating the application of the bias power before oxidization proceeds, as recited in claim 1.

Again, the reasons for initiating the etching of the material containing silicon by applying, the bias power are as follows. For example, after supplying the process gas composed of chlorine and oxygen to the chamber in which the material containing silicon is provided, the bias power is applied and then plasma including chlorine ions and oxygen radicals are generated. At this time, the electric field generated by the application of the bias power accelerates the chlorine ions toward the material containing silicon. Hence, since the accelerated ions reach the material containing silicon before the oxygen radicals, which moves randomly, etching is initiated by the chlorine ions before the oxygen radicals oxidize the material containing silicon, as disclosed on page 38, lines 2-26 of the present specification.

Claim 3, for example, of the present invention further distinguishes from Jain by reciting the step of applying the source power and the bias power such that an effective value

of the source power reaches a second predetermined value after an effective value of the bias power reaches a first predetermined value. The Examiner appears to have not fully addressed the features of claim 3.

For the foregoing reason, the present invention is distinguishable from that of Jain.

With respect to Yang, according to the Examiner, the reference discloses the feature using the dry etching apparatus having the dual power source to independently apply the high source power to the chamber and the bias power to the substrate as the dry etching method for the conductive film containing at least silicon formed on the substrate. Further, Yang discloses a source power ionizes the gas supplied into the chamber, and generates the reactive species in the chamber. The bias power on the substrate drives the reactive species to accelerate the reactions. Hence, there is more control of the etching process, the source power controls generation of the chemical species and, therefore, controls generation of the chemical etch portion, and the bias power controls the physical part of the etch, for example the bombardment of the species onto the substrate (see column 6, line 10-22 of Yang). Yang seems to suggest initiating etching by simultaneously applying the source power and the bias power. Hence, Yang can generate the plasma and drive the reactive species to the substrate at timely manner and etch efficiently, as asserted by the Examiner.

In response to the application of Yang, Applicants respectfully submit that one of the features of the present invention resides in the feature wherein the application of the bias power is initiated to generate plasma before oxidization proceeds at the surface of the material containing silicon, as explained above. Hence, before oxidizing the surface of the material containing silicon, the ions in the plasma generated by the application of the bias power can be drawn into the material containing silicon by the application of the bias power (see page 36, line 25 to page 37, line 8). In other words, in the presently claimed invention, the etching of the material containing silicon is substantially initiated by the application of the bias power. Applicants respectfully assert that Yang completely fails to disclose "initiating etching by generating plasma by the application of bias power" as recited in Applicants' claimed invention. Yang also fails to teach disclose or suggest the application of the bias power is initiated to generate plasma before oxidization proceeds at the surface of the material containing silicon.

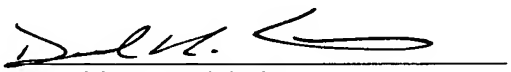
Moreover, the presently claimed invention further distinguishes from Yang by the

features recited in, e.g., claim 6, which includes the step of applying the source power and the bias power such that an effective value of the source power reaches a second predetermined value after an effective value of the bias power reaches a first predetermined value. Applicants respectfully submit that the Examiner appears to have failed to fully address the features of claim 6.

The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. As both Jain and Yang fails to teach, disclose or suggest all of the claimed features, as discussed above, a *prima facie* case of obviousness has not been established.

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that claims 1-7 be allowed, that new claims 14 and 15 be allowed and that the application be passed to issue. If a conference would expedite prosecution of the instant application, the Examiner is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,



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